AN ASSESSMENT OF VERTICAL MAPPER
FOR EXAMINING CRIME CONCENTRATION

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INTRODUCTION
Vertical Mapper is a program that works with MapInfo to locate spatial concentrations. The output appears like a topographical (contour) map but instead of the contours representing height above sea level, they represent the concentration of the events, people, or things being mapped. For criminal justice and criminological work, we are usually referring to the concentrations of crime.

UNDERLYING ALGORITHM
Vertical Mapper begins by defining an evenly spaced grid for the map being analyzed. Each point where a vertical grid line and a horizontal grid line cross is called a node. Each node is given a value based on its relationship to surrounding data points. Though the grid is evenly spaced, the data being examined are not. Therefore, Vertical Mapper interpolates using one of three methods:

- The averaging process assigns each node a value based on how far the average distance of near-by data points are from the node. "Near-by" is defined by the user as the search radius, and data points far from the node, but within the search radius, are given less weight than near-by points.
- The triangulation process connects each point to two other near-by points in such a way that a network of linked triangles is formed. This is known as a Triangular Irregular Network, or TIN. Vertical Mapper then fits a grid to the TIN to calculate the values of the nodes.
- Rectangular interpolation operates similar to triangular interpolation, but instead of a triangle, a four-sided polygon is used to produce the network.

Location profiler looks for sites that are geographic centers of activity. It establishes a grid and calculates the shortest average distance to locations in the search area. Nodes that are close to many points get higher values than nodes close to few points.

Three settings are critical to using location profiler, but the choice of the value for each setting is arbitrary. The first setting is the search radius. This has been described above. The second setting is the number of data points to be included in the analysis. Vertical Mapper defaults to 100% of the points, meaning that all points are included and a single peak is located. Reducing the percent of points can increase the number of peaks, or hotspots. The third setting is the weighting of the points. Each point (or address) can be

assigned the same weight, or the user can assign them weights. The user might select weights based on the number of crimes at that location or on a distance decay function (points closer to the node are given higher values than points further away).

Ideally, we would have powerful theories or studies that could guide the selection of the search radius and percent of points. Unfortunately, we do not. Offender search theory of research on crime places can help set the weights, but only in the most general sense. Therefore, the settings must be established by trial and error. This time consuming process might work, except we usually have no way of knowing whether a particular trial is accurate or in error. Final selection of these two settings will result in a map with unknown errors – some hotspots on the Vertical Mapper map will not be real hotspots, and some real hotspots on the ground will not be identified.

One way of thinking about this problem is to imagine using a set of binoculars to look at a bird, say a wren. If it is fuzzy you turn the focusing knob until the wren looks like a wren and not a dust bunny. This only works because you know what a wren looks like. If you were on some strange planet looking through your binoculars you might not know whether the creature was in focus and fuzzy or out of focus. This is the situation we have with mapping crime clusters. The focusing knobs in Vertical Mapper are the various settings. Unfortunately, you often have no idea of what you are looking for or at, so it is impossible to determine if it is "in focus."

USER FRIENDLY
This is not a user friendly program. The documentation is incomplete and difficult to follow. Users will have to receive special training in order to use it and should be prepared to call for technical assistance. The "test analyst" applying Vertical Mapper at the W/B HIDTA was a graduate student seeking her Masters Degree in Criminology who could devote considerable time to this test. The following are the major concerns she found.

- Import/Export Issue : Data originating from MapInfo do not pose import/export problems for Vertical Mapper. However, in order for MapInfo to recognize the data, its projection must be transfigured from the customary Latitude/Longitude system to a **Universal Transverse Mercator** setting. The <u>Save Copy As</u> command will readily allow for this conversion. While the Vertical Mapper User's Guide mentions that the program cannot operate in a Latitude / Longitude setting, it fails to define the proper projection.

- Setting and Adjusting Parameters : Vertical Mapper technicians have been unable to perfect the setting and adjustment parameter function of this program. While the user is free to set and adjust search and grid parameters, the ideal setting can only be obtained through constant manipulation of the data. Advanced knowledge of geography, cartography, and geographic information systems might help an analyst to restrict the number of possible options.

- The 0.000 coordinate: The User's Guide also failed to inform the reader that if the data set contains a 0.000 coordinate, the Vertical Mapper will be unable to produce a workable map. Instead of generating a map of hotspots in Baltimore County, it created a map with one hotspot atop the entire county and another hovering over the equator.

- The elevations column: For use in repeat address situations, an elevations column needs to be created. This column contains the total number of crimes or calls for service at each address. Vertical Mapper uses this column to determine crime concentrations. Nevertheless, it is not mentioned in the manual.

- Layer accessibility: Vertical Mapper creates multiple layers for each map but not all of these layers are accessible to the user. If one of these layers has a problem, the analyst must start over.

- Color settings: A color gradation is used to show elevation or crime concentration. The analyst can change the colors in the profiler. Unfortunately, the program does not remember the user defined color profile, and reverts to the default scheme. This means that the color scheme must be reset each time a user creates a map.

- Computer resources: The program uses a great deal of memory and hard drive space. We had to increase RAM significantly and work off of our network when we exhausted hard drive space (prior to this trial there had been sufficient memory and hard drive space to run MapInfo locally).

- An unknown sporadic problem: Sometimes, when we tried to overlay the crime spots over the Vertical Mapper image of the concentration, the Vertical Mapper image would disappear. When this occurred, the best solution was to shut down the system completely, turn off the computer, and start from scratch. However, this problem did not always arise when such maps were being produced and we are at a loss to explain why they occurred or what to do about it.

FACE VALIDITY

Comparisons of the Vertical Mapper maps with the crimes plotted on a spot map suggests that Vertical Mapper misses some clusters and depicts clusters where there are none. It also can produce fictitious clusters in areas outside of the base map for which there are no data.

We found that Vertical Mapper produced maps with greater face validity when only repeat addresses were used rather than every address with a burglary or a robbery. In fact, the maps using all of the addresses make no sense at all.

PRACTICAL UTILITY
For practitioners having to produce maps for operational decision makers, Vertical Mapper has little practical utility. Large scale spot maps are more reliable and easier to produce. For a researcher with a great deal of time on her hands, Vertical Mapper might be useful for testing hypotheses about expected crime clusters. There are so many settings that need adjusting, all without any theoretical or empirical guidance, that there are an infinite number of possible maps and no way of objectively selecting among them.

PROGRAM FLEXIBILITY
Vertical Mapper is based on a MapInfo environment. We do not know if it can be adapted to other environments. For most common crime analysis functions, this program is not particularly flexible.

BEST AND WORST
Graphics are great. With a color printer the maps look gorgeous. The phone help provided by the Vertical Mapper technical support was excellent. But the program is very awkward and the maps are highly unreliable. It uses considerable file space. Though it comes with a readable manual, there are many things left out of it that have to be learned by calling for technical assistance, going to training courses, commiserating with other users, and trial and error.

SUMMARY
We cannot recommend this software for crime analysis work. It may have some utility for research workers who have considerable time and perseverance.